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Trends in ITN Use Prevalence among Children Attending for Malaria Diagnosis in the Main Sentinel Site for Malaria Surveillance of Gabon: Data from 2010 to 2020

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The aim of this study was to assess the trends of ITN use and age disparities among children attending for malaria diagnosis in the main sentinel site for malaria surveillance of Gabon.
Methodology: Data were collected from September 2023 to October 2023 at the malaria sentinel site for malaria survey of the Regional Hospital of Melen in Gabon. Data from 2010 to 2020, including age, gender, years of screening and ITN use the night before the consultation were reported on a case report form.
Results: Data from 13687 children were analyzed, the rate of ITN use was 57.7% (n=7902). The trend of ITN use decreased significantly from 76.2% in 2011 to 41.9% in 2017, with a slight increase until 2019 (54.9%). According to age, use of ITN was more frequently reported in infants (64.1%) and children aged between 2 to less than 5 years (57.1%) compared to older children (53.1%) and adolescents (51.2%) (*P<0.01*). Although the rate of mosquito net use significantly decreased in all the age groups, the odds of net use remained the highest in children under 5 years and lowest among the adolescents (*P<0.01*).
Conclusion: The ITN use coverage is still insufficient in Libreville. Efforts should be done to achieve the universal coverage of ITN ownership and use toreduce malaria transmission in Gabon.

Keywords: Malaria; ITN use; children; Gabon.

1. INTRODUCTION

Malaria remains a major public health problem in many developing countries. In 2021, an estimated 247 million cases of malaria occurred in worldwide, with 63000 deaths due to malaria: high mortality rates (76%) among children aged under 5 in the WHO African region was reported [1]. Among preventive measures, insecticide-treated nets (ITNs) are one of the proven cost-effective components of malaria prevention through vector control approach [2]. In Western Kenya, ITNs were associated with a reduction in the incidence of malaria parasitemia [3]. ITNs have been shown to reduce the number of infective mosquito bites by 70 to 90% in various geographical settings [4]. Moreover, the percentage of the population sleeping under an ITN increased considerably between 2000 and 2021, for the whole population (from 2% to 47%), for children aged under 5 years and for pregnant women (from 3% to 53%) [1].

In Gabon, changes in malaria morbidity were observed between 2008 and 2020; data from the Malaria National Control Program (MNCP) highlighted prevalence ranging from 13% in 2008 to 40% in children under five years with a mortality rate of 120 per 1,000 inhabitants in 2020 [5]. ITN use is recommended since 2003 in Gabon and distribution campaigns are performed by the MNCP or private donors in the 56 departments of the country. Although, coverage of 48% and 64% to 75% are noticed in urban in rural areas respectively, the prevalence of malaria does not follow the same trends. Indeed, it is significantly lower in urban regions (20-36%) compared to rural settlements where it can reach 80% [6-8]. Moreover, ITN ownership does not often correspond to ITN use [5,9]. Assessing trends in mosquito net use by vulnerable populations such as children and pregnant women, would help to update policymakers' decision on malaria prevention needs. However, this information is most often provided by demographic health surveys, which are conducted every 10 years in the country [10,11]. As a result, data from the time period between two DHSs is scarce, although key information can emerge and lead to specific actions.

Trends in bed net ownership and use could be monitored through malaria sentinel sites where every day febrile patients and pregnant women are screened for malaria. The aim of this study was to assess the rate of ITN use and its relationship with age from 2010 to 2020, among children attending the main sentinel site for malaria surveillance of Gabon.

2. METHODS

Data were collected from September 2023 to October 2023 at the malaria sentinel site for malaria surveillance of the Regional Hospital of Melen (RHM) in Gabon. The main activity of the sentinel site consists of the screening febrile patients for malaria performed by the team of the Operational and Clinical Research Unit (ORCU). Thus, age, gender, day of screening and ITN use the night before the attendance at the sentinel site are regularly collected using the register of the sentinel site. Data from 2010 to 2020 were reported on a dedicated form.

2.1 Statistical Analysis

All data were analyzed using Statview 5.0 software. The qualitative ones such as frequency were used and compared with the bivariate Chi-Square or Fisher Exact tests. Association of ITN use with age was examined using a bivariate analysis and results were expressed as crude Odds ratios (OR) and 95% confidence intervalley (95% CI). *P value* below 0.05 was considered statistically significant.

3. RESULTS

Data from 13687 children were analyzed. Their median age was 36[14-84] months. The sex ratio was: 1.1. The majority (62.4%; n=8536/13678) of the children were aged below 5 years old. More than 40% (n=5505) consulted after 2017 (Table 1).

Globally, the prevalence of ITN use was 57.7% (n=7902/13687), it significantly decreased from 2011 (76.2%) to 2017 (41.9%); then it slightly increased until 2020 (51.5%) (Fig. 1).

According to age, children who slept under an ITN were significantly younger (36[12-72] months) than those who did not (42[18-96] months (*P<0.01).*

Table 1. General characteristics of included children

Variables	N	%
Age (N=13678)		
< 2 years	4690	34.3
[2-5[years	3846	28.1
[5-10] years	3447	25.2
[11-18] years	1690	12.4
Gender (N=12438)		
Female	5998	48.2
Male	6440	51.8
Years (N=13687)		
2010	447	3.3
2011	1052	7.7
2012	769	5.5
2013	1076	7.9
2014	1245	9.1
2015	2058	15.0
2016	862	6.3
2017	683	5.0
2018	1841	13.4
2019	1724	12.6
2020	1940	14.2

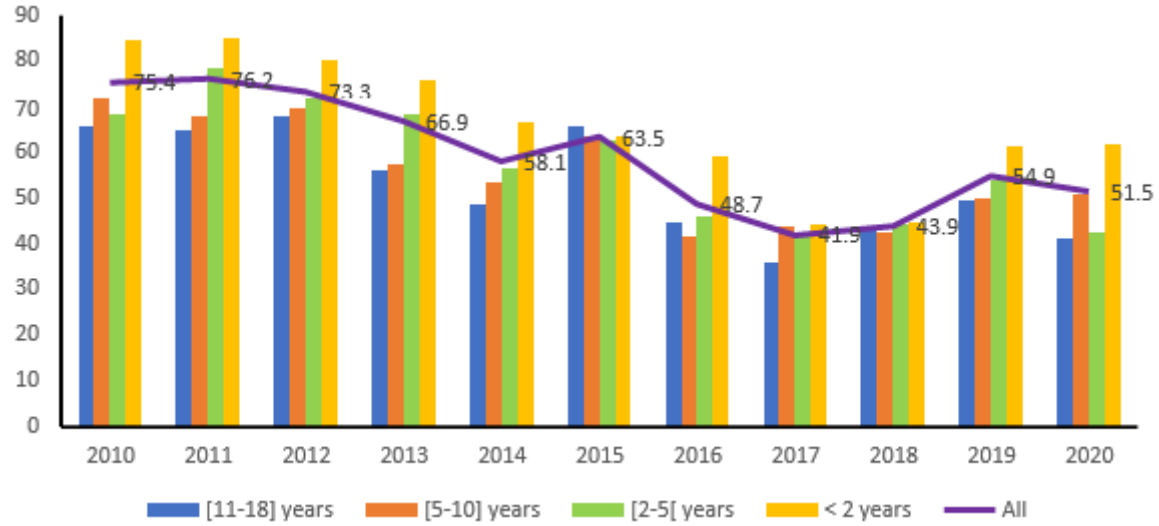

Fig. 1. Trend of bed net use among children according to age

The frequency of ITN use was 64.1% in infants (ranging from 84.7% in 2010 to 61.8% in 2020 (*p<0.01*)), 57.1% in patients aged between 2 and 4 years (from 68.5% in 2010 to 42.5% in 2020 (*P<0,01*)), 53.1% in the 5-10 years old ones (from 71.7% in 2010 to 50.7% in 2020 (*P<0.01*)), and 51.2 % among the adolescents (from 65.8% in 2010 to 41.2% to 2020 (*P<0.01*)) (*P<0.01*) (Fig. 1). ITN use was equally performed for girls (57.2%; n=3431) and boys (57.7%; n=3714) (*p=0.61*).

The bivariate analysis showed that throughout the study period, children under 2 years of age had the highest odds of using an ITN compared to older children, except in 2017 (Table 2). There were no significant differences in odds of ITN use between children aged 2-5 years and those aged 5-10 years (Table 2). In 2014 (OR: 1.46[1.16-1.85], *p<0.01*) and in 2020 (OR: 1.85[1.53-2.22], *p<0.01*), children under 5 years of age were more likely to sleep under an ITN compared to children aged 5 to 18 years (61.8% compared to 42.2% in 2014; 57.1% compared to 42.0% in 2020, respectively). In 2010 (87.5% versus 76.2%; *p=0.78*), and in 2017 (61.8% in children under 5 years versus 52.2%, *p<0.01*), odds of ITN use were not statistically different between the two age groups.

4. DISCUSSION

This study assessed the trends in ITN use over a period of 11 years in patients attending in a sentinel site for a malaria surveillance in Gabon. This is one of the first largest report of the country which included data from more than 13.000 children, the most vulnerable populations affected by malaria. Our results show that the rate of ITN use was 57.7%, this is far from the MNCP goal which is a coverage of 80% [12]. ITN use coverage was lower than that reported in Democratic Republic of Congo (78,4%) and Eastern Ethiopia (62,4%) [13-14]. Data from rural areas highlight a higher utilization of ITN ranging from 73.3% to 83.6% in 2011-2012, 2018 and 2019 respectively [6-8]. Overall, ITN ownership and use rates are higher in rural versus urban areas [11]. The slight decrease observed in 2020 was probably due to the lock down during the acute phase of the COVID-19 pandemic which has strongly reduced the MNCP activities; awareness and mass distribution were not performed this year. During the DHS performed in 2011 and 2022 in Gabon, the rate of household ownership also significantly decreased from 36% in 2011 to 21% in 2019- 21 [10-11]. These surveys included households from the nine provinces of the country, thus the trends of ITN use described in the present study is in line with the 10 year decrease of ITN ownership observed in Gabon. In Ethiopia, bed net use significantly decreased among pregnant woman from 2010 (83.6%) to 2016 (36.5%) [15]. After, the Abuja Meeting in 2000 and with the Global Fund support, most of the African endemic countries implemented the

ITN through free distribution campaigns. Five to seven years after awareness campaigns and ITN distribution significantly decreased when this support ended in Gabon. The government did not immediately take over from the global fund. Indeed, the country submission to Global Fund performed in 2012 and 2015 were unsuccessful. After 2013, the number of ITNs to be distributed dropped drastically, and no big mass campaign was organized between 2016 and 2019. Some were performed by local actors notably, from private sectors. It is known that awareness campaigns combined with ITN distribution lead to higher rates of net use compared to self-purchase [16]. Indeed, the source of mosquito net ownership also contributes to the rate of ITN use: owing a net often result in alternative and incorrect use because this is not accompanied by awareness campaigns, which are more frequently associated with free distribution campaigns. Awareness increases the adherence of the population who accept to sleep under a net, it also improves access to ITN [16-18].

Not surprisingly, when the country benefited again from the Global Fund support, the number of campaigns increased. In Burkina Faso, the government has set a national goal to increase ownership, access, and use of bed nets, and has carried out two large-scale free mass distribution campaigns [19]. The authors report a significant increase in net ownership per household, from 5.6% in 2003 to 89.9% in 2014 [19]. This strategy of free ITN mass distribution has been shown to rapidly extend the ITN ownership in low-coverage areas and to reduce social inequalities [20,21]. However, these campaigns should not be the only mechanism by which ITN are distributed in the community. Free distribution during prenatal consultations for pregnant women and at vaccination centers for children would also help to increase household coverage of bed nets [22]. These strategies have been used in Gabon. ITNs could also be sold in stores at reduced prices, making them available to all. Net purchase combined with sufficient knowledge and awareness campaigns on the need of sleeping under an ITN will also help to increase ITN access in our country [23]. Moreover, a strong commitment of the government with a dedicated budget line for the prevention of malaria is also an important to achieve high rates of ITN ownership and use [24]. Other alternative strategies could be the distribution of nets in schools and the integration of community health worker into MNCP teams [25].

As expected, young children more often slept under mosquito nets than older children. A multi-country analysis of trends in mosquito net use in Sub-Saharan African reports that children under 5 years and pregnant women are more likely to sleep under ITN compared to the other family members [23]. Sleeping under an ITN is systematic for newborns and infants; indeed, mothers' benefitfrom a free ITN when they go to antennal care visit and if they don't sleep with their baby, they purchase an ITN that is placed on their cribs until they are 2 to 3 years old. Moreover, prior to 2015-16, only children under the age of five and pregnant women were prioritized for the he free distribution of ITN Gabon, like observed elsewhere [26]. Net use depends on the household size and the number of ITN per house. In household with not enough ITN, high disparities on ITN use are observed according to age and pregnancy status [22,23]. The EDS performed in Gabon highlighted that in household with at least one ITN, the rate of its usage the last night before the EDS was 72% in 2011, it was of 68% in 2021, higher than the other family members [11]. Consistent with these findings, bed net coverage was generally lower than 45% in school-aged children (5-18 years) attending for a malaria diagnosis in the sentinel site, this age-group is now more frequentlyinfected by *P.falciparum* compared to the youngest [27]. One explanation is that they are mot prioritized in their house and they are not considered as target for free net distribution during mass campaigns, most probably because of insufficient number of available nets. Furthermore, it is also likely that adolescents simply refuse to sleep under an ITN.

Table 2. Odds ratios of itn use by age

All			**<2 Years**		**[2-5 [Years**		**[5-10] Years**		**[11-18] Years**
	OR [95%CI]	*P*	OR [95%CI]	*P*	OR [95%CI]	*P*	*OR* [95%CI]	*P*	
2010	1.05 [0.81-1.36]	0.73	2.97 [1.31-6.29]	<0.01	1.13 [0.53-2.44]	0.70	1.31 [0.59-2.90]	0.50	REFERENCE
2014	0.45[0.36-0.58]	<0.01	2.11 [1.43-3.12]	<0.01	1.37 [0.93-2.03]	0.11	1.23 [0.83-1.82]	0.32	REFERENCE
2017	0.21 [0.18-0.31]	<0.01	1.40 [0.82-2.44]	0.21	1.27 [0.79-2.04]	0.33	1.40 [0.87-2.26]	0.17	REFERENCE
2020	0.35 [0.27-0.44]	<0.01	2.36 [1.76-3.16]	<0.01	1.50 [1.11-2.03]	<0.01	1.08 [0.79-1.47]	0.63	REFERENCE

5. CONCLUSION

The ITN coverage, which is a key component of strategies for malaria control and prevention, is still insufficient in Libreville. Effort should be done to increase ITN ownership and use to achieve a significant reduction of malaria transmission in Gabon. Engagement of the government, continuous awareness campaigns, increased ITN distribution during antenatal visits, expanded immunization program activities and within the communities, are needed to reach the national ownership and use coverage targets.

6. LIMITATION OF STUDY

This study has one limit. ITN ownership and the number of inhabitants in the children house were not recorded. This information is essential to adjust strategies to achieve effective coverage and protection against mosquitoes and a reduction in malaria transmission. However, obtaining information on the actual use of ITNs is an important performance indicator for the MNCP, which will be able to adapt its strategies according to the distribution rate of bed net. A prospective household survey assessing this information would complete our data.

CONSENT AND ETHICAL APPROVAL

This study was carried out at the sentinel site of malaria survey, which works with the Malaria National Control Program (MNCP) and the Ministry of Health. The study team received the approval of the MNCP director and the Medical Director of the RHM for data use. All participant data were anonymized.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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